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Use of Sparrows *(Passer domesticus)* in Western Equine Encephalitis Monitoring in Manitoba, 1983-1986.

By Emil Kucera, Ph.D.

Manitoba
Environment
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ABSTRACT

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During the summer months of 1983 through 1986, Manitoba Environmental Management Division has monitored the incidence of Western Equine Encephalitis (WEE) antibodies in wild birds, in order to assess any impending danger of its spread to humans. The house sparrow (*Passer domesticus*) proved to be the most useful biological indicator of the prevalence of the virus, because of its abundance, wide availability, and unprotected status. The percentage of sparrows that tested positively for WEE virus antibodies declined from a peak value of 5.3 % in 1983, a declared health emergency year, to 0% in 1986. It is concluded that an increase in the proportion of seropositive house sparrow samples to 5 percent or more will signal a potential WEE outbreak similar to the one which occurred in 1983.

TABLE OF CONTENS

ABSTRACT i

TABLE OF CONTENTS ii

LIST OF TABLES ii

INTRODUCTION 1

METHODS 3

RESULTS AND DISCUSSION 5

CONCLUSION 9

ACKNOWLEDGMENTS 9

LITERATURE CITED 10

LIST OF TABLES

Table 1. Sampling locations and total catch of sparrows 13

Table 2. Number and percentage of sparrows that tested positive for presence of antibodies to WEE 14

INTRODUCTION

Monitoring of the incidence of Western Equine Encephalitis virus antibodies in wild birds in Manitoba began in 1983, during the province's most recent outbreak of the disease among humans.

The importance of birds in the natural cycle of the virus has been widely acknowledged since publication of the work of Reeves and Hammon (1962). Because this arthropod-borne virus also infects humans, its increased incidence in other hosts suggest increased risk for people, particularly when populations of the carrier mosquitoes are also high. Birds serve both as reservoirs and as amplifying hosts of the encephalitis virus (Hess and Hayes 1967, Holden et al. 1973a, Ludwig et al. 1986), and are probably instrumental in its geographical spread (Calisher et al. 1988). They have been monitored in several virus surveillance programs concerning WEE and other arboviral diseases both in North America (e.g., Clark et al. 1977, Dorland et al. 1979, Lord and Calisher 1974, Williams et al. 1971) and on other continents (e.g., Bhattacharya et al. 1986, Juricova et al. 1987, Traavik et al. 1985).

In the absence of local data from previous years, the objectives of the Manitoba program since its inception in 1983 were to determine the prevalence of antibodies to WEE, to compare the results with available data from other areas, and to establish a

baseline to which future data could be compared (Kucera and Sawatsky 1984). The results from 1983 had to be compared with data from following years because, as with all studies of this nature, a longer period of data collection provides more valuable information and allows greater confidence in the conclusions.

METHODS

In 1983, birds were sampled at 25 locations, near all communities that were designated at risk by the Minister of Health (Kucera and Sawatsky 1984). In subsequent years the sampling was continued, with minor modifications, in those areas where birds with WEE antibodies were found in 1983. Sampling sites were, as a rule, located in or near farmyards within 5km of the designated towns (Table 1). Two to five mist nets were placed at each site and moved only if catch was low. Every site was visited three times per season, if possible. Where available, unfledged sparrows still in nests were also sampled. While blood samples were taken from from all songbirds in the first year, only house sparrows were sampled after 1983 because very few other birds were caught at the sampling sites.

The evaluations in this study involve only the sparrows, which reduces sources of variance and allows more direct year-to year comparisons.

To obtain a blood sample, the area of the brachial vein was cleaned with an alcohol swab, the vein itself was punctured with a sterile 22-gauge needle, and blood was drawn into a sterile Pasteur pipette. From 1984 on, the pipettes were rinsed with an anticoagulant, and the blood was transferred directly into a vial with diluent (Ca- and Mg-free, phosphate-buffered saline

with sterile Gentamycin, pH= 7.3). This procedure, combined with cool storage of the samples (at 4° C) prevented premature coagulation.

The Cadham Provincial Laboratory tested all samples for WEE antibodies as soon as possible after collection. The hemagglutination inhibition (HI) method (Sekla and Stackiw 1976) was used.

RESULTS AND DISCUSSION

Blood samples were obtained from 1,821 sparrows during four summers of monitoring. Table 1 shows the locations, sample sizes, and numbers of samples in which antibodies to WEE were detected (marked with superscript numerals).

In the first year, all samples with HI titres 1:10 or greater were reported as positive (Kucera and Sawatsky 1984). Later, the laboratory reported as positive only those with titres ≥1:20. The comparisons in this report reflect the revision, thus the percentages shown here for 1983 are slightly lower than those reported originally by Kucera and Sawatsky (1984).

The number of positive samples declined by 50% from 1983 to 1984. There was little difference from 1984 to 1985, and no positive samples were encountered in 1986, the last year of the study. The overall trend is highly statistically significant ($x^2=31.515$, $p<.001$). Table 2 presents a breakdown of the number of birds sampled during each year and the proportion of seropositive blood samples.

The increased percentage of seropositive adult birds in 1984, the year after the epidemic, is explained by the influx of birds that were infected as juveniles, in the previous year. Antibodies persist in older birds from year to year, although the antibody

titre may decrease slowly over the years subsequent to the infection (Holden et al. 1973 b). The drop to 0% in the last year most likely results from a combination of such decrease and the natural mortality rate of the adult birds.

The decline from first to second year was most apparent in the juveniles. Although there was a higher percentage of positive juveniles in 1985 then in 1984, the 1.6% incidence of infection, while significantly different from previous year's 0.5% statistically, is probably of less significance biologically.

The results indicate that the normal proportion of WEE infected birds is in the 0 - 2 percent range in Manitoba. Thus it is likely that most birds infected in 1983 acquired the virus during that year. Consequently, a sudden rise of the percentage of seropositive sparrow blood samples during early summer to 5 percent or more would be biologically significant and indicative of impending danger of the infection spreading to humans.

The percentage of seropositive birds recorded in Manitoba, even for 1983, is lower than what was published for other jurisdictions (Burton et al 1966; Holden et al. 1973 a; Hayes and Wallis 1977). However, as discussed by Kucera and Sawatsky (1984), the data are not necessarily directly comparable. Geographical differences, different methodology and interpretation (e.g. what constitutes an "epidemic year" or at what titre is a sample positive) all play a role. Human

populations may have developed different level of resistance to the virus in different locales. Climatic factors were found to be important in the dynamics of St.Louis encephalitis (Day and Edman 1988). Bird population density (both of sparrows and other birds) probably is another significant factor in the transmission of the virus (Dr. J. Iversen, Western College of Veterinary Medicine, Saskatoon, pers. comm.; Bhattacharya et al. 1986). In addition, in Manitoba in 1983 the spread of the virus may have been already arrested to some extent before the survey was initiated, because pesticide spraying had already started. In view of that, the rise to a 5-percent level given above as indicative of an outbreak is a conservative estimate that may include some (unknown) margin of safety.

Bird sampling is not the only method for monitoring the WEE. In Manitoba, mosquito trapping and analysis (Raddatz 1982, Sekla and Stackiw 1982), as well as monitoring of sentinel flocks of chicken (Wong and Neufeld 1982, Neufeld and Wong 1982) has been used for the purpose for a number of years before the present study. Although one recent study concerned with the Eastern equine encephalitis found the chicken flocks ineffective (Crans 1986), Manitoba experience in monitoring the Western equine encephalitis found them very useful. Sentinel chicken flocks were maintained in several areas of the province, and Wong and Neufeld (1982) stated that a minimum of six flocks provide sufficient predictive data. However, chicken flocks must be established and maintained, while sparrow monitoring is more

flexible in this respect. The mosquito trapping has largely been restricted to the City of Winnipeg, therefore, while mosquito counts may suffice to trigger a response by the City, rural areas do not have similar programs, and must rely on Provincial agencies for a warning of a WEE outbreak.

Sparrow sampling in 15 locations normally allowed three visits per site, even with only one crew (sometimes one person) to carry out the work. Timing of the surveys corresponded well with the period when students seek summer employment, which helped to keep the costs low. The method can supplement, if not supplant, other ways of assessing the danger of a WEE outbreak in humans.

Although beyond the scope of this report, the question of what is to be done when monitoring programs do signal a danger of such an outbreak should be mentioned. It is far from settled. During the last two WEE outbreaks in Manitoba, the Minister responsible declared a health emergency, and the mosquito populations were controlled by fogging and aerial spraying (Sekla 1982, EMD 1983). Effectiveness of spraying vs. other measures (fogging, personal protection etc.) is difficult to assess (Eadie 1982); moreover, such chemical control is subject to a controversy as well. Gahlinger et al. (1986) discussed the roles of personal habits and behaviour in the decline of WEE incidence among humans. Final decisions regarding mosquito

control must invariably be political, even if based on technical advice. An insightful discussion of the problems with spraying was presented by Ronald (1982) and others (*in* Sekla 1982).

CONCLUSION

Monitoring the WEE virus antibodies in wild birds is a feasible alternative or supplementary technique which can provide an early warning of potential spread of the disease to humans. In Manitoba, an increase in the number of seropositive samples to 5 percent or more of the house sparrow population will indicate a potential WEE outbreak of a magnitude similar to that which occurred in 1983.

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Table 1. Sampling locations and total catch of sparrows. Numbers in superscript denote number of seropositive (hemagglutination titre ≥1:20) samples.

Year	1893	1984	1985	1986	Total
Altona	2	--	--	--	2
Beausejour	12^{1}	32	31^{1}	52	127^{2}
Brandon	8	10	14	39	71
Carman	12^{1}	33^{1}	33^{2}	53	131^{4}
Dauphin	9	--	--	--	9
Dugald	2	--	--	--	2
Gimli	9		--	--	9
Headingley	3	29^{2}	20	61	113^{2}
Deloraine/Boissevain	10^{1}	29	--	--	39^{1}
Killarney/Boissevain	11^{2}	36^{2}	31^{1}	40	118^{5}
Minnedosa/Neepawa	9	26^{1}	15	40	90^{1}
Morden	3	--	--	--	3
Morris	8	--	37^{2}	54	99^{2}
Niverville	4	--	--	--	4
Portage la Prairie	4^{1}	22	24^{2}	41	91^{3}
Roblin	9	--	--	--	9
Russell	8^{2}	19^{1}	7^{1}	40	74^{4}
Selkirk	4	--	25	50	79
Ste Anne	4	--	--	--	4
Steinbach	9	6	43	56	114
Stonewall	7	10	36^{3}	57	110^{3}
Swan River	16^{1}	31^{1}	34	40	121^{2}
Virden	8^{1}	31^{1}	13	40	92^{2}
Winnipeg	17	95^{2}	72	126	310^{2}
Total	188^{10}	409^{11}	435^{12}	789^{0}	$1,821^{33}$

Table 2. Number and percentage of sparrows that tested positive for presence of antibodies to WEE (Positive = HI titre ≥ 1:20)

Year	ADULT Tested n	ADULT Positive n	ADULT Positive %	JUVENILE Tested n	JUVENILE Positive n	JUVENILE Positive %	TOTAL Tested n	TOTAL Positive n	TOTAL Positive %
1983	128	6	4.7	60	4	6.7	188	10	5.3
1984	188	10	5.3	221	1	0.5*	409	11	2.7*
1985	178	8	4.5	257	4	1.6*	435	12	2.8
1986	313	0	0.0*	476	0	0.0*	789	0	0.0*

* significantly different from previous year ($p<0.05$)